Rhizoid Differentiation under Low Temperature Condition in Fucus Eggs

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Abstract

Fucus evanescens eggs, just after liberation, were stored with sea water in the dark at 3°, and inspected every 12 hour. As a result, it was found that (1) 14% of the eggs developed rhizoid protuberance 72 hour after the start of the storage and 68% in 96 hour. The protuberance thus formed does not give rise to an elongated rhizoid under the cold storage. (2) If the cold-stored eggs are taken out, and cultured at room temperature (about 18°), almost all of them form rhizoid. The longer is the time of the former cold storage, the shorter is the time for germination. (3) When the eggs are cultured with IAA (100 ppm), coumarin (100 ppm), 8-azaguanine (saturated), colchicine (50 ppm), GA3 (1000 ppm), and kinetin (10 ppm) at room temperature, the protuberance appears but it does not develop to a rhizoid.

Generally, the developmental process in Fucales eggs is commenced by transformation of the initial spherical form to the peculiar form having a protuberance on one side of the egg. Then the tapered end differentiates into the primary rhizoid or rhizoids. In Sargassum confusum, the eggs are discharged in an ovate form from the conceptacle, in Coccophora, tapering at one side of the egg results from for-

Table 1. Germination rate of Fucus eggs during cold storage at 3°, and within 12 hours incubation at room temperature (about 18°) after being transferred from cold storage every 12 hours.

<table>
<thead>
<tr>
<th>Cold-stored time (hr)</th>
<th>Germination rate during cold storage (%)</th>
<th>Germination rate within 12 hour room temperature incubation after cold storage (%)</th>
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<tr>
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</tr>
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</table>

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mative movement of the egg itself after fertilization, and in Fucus eggs, the protuberance occurs not by mere movement but by additional formation of cell wall on one side of the egg. Since the tapered end of the eggs does not always develop into an actual rhizoid, the protuberance formation should be distinct from net rhizoid formation though is an initial step of the latter. In this connection, Nakazawa and Takamura have divided the process of rhizoid formation into three steps, namely, (1) rhizoid differentiation, (2) primary and (3) secondary elongation of rhizoid. They distinguish the first step from the second because of the fact that Fucus eggs treated with actinomycin D (75 ppm) formed the protuberance but failed in its successive growth. Therefore the newly synthesized ribonucleic acid seems to be required for the following growth of the protuberance.

The author reports some informations on the above problems obtained with Fucus eggs in rhizoid formations under low temperature conditions.

Fertilized eggs of Fucus evanescens were stored at 3°C in normal sea water in the dark just after being discharged from the conceptacles. The eggs, thus cold-stored, were observed at every 12 hour intervals for four days, and the germination test was also performed transferring the stored eggs to room temperature (about 18°C). During cold storage, there was no morphological change on the eggs within 60-hours. Later, however, though under the cold condition, rhizoid differentiation appeared gradually after 72 hours and about 70% of the eggs germinated in 96 hours' storage (Table 1). It was found that at least within four days, the rhizoid protuberance does not show further development at 3°C (Fig. 1). It is also apparent from Table 1 that the longer is the cold-stored time, the shorter is the time required for germination when transferred to room temperature. These results indicate that the preparation for rhizoid differentiation in the eggs had been going on even under the cold conditions though at a slow rate. According to Nakazawa and Takamura, rhizoid differentiation of Fucus eggs involves cell wall synthesis, therefore, it is apparent that its synthesis could occurred even in low temperature, 3°C.

Nakazawa has found rhizoid differentiation without its further development when reared the Fucus eggs in 10^-3 M of β-mercaptoethanol contained in sea water under room temperature and diffuse light. The same results were found in chronic treatment with relatively higher level of
indole-3-acetic acid (100 ppm), coumarin (100 ppm), 8-azaguanine (saturated in sea
water), colchicine (50 ppm), gibberellic acid (1000 ppm), and kinetin (10 ppm). Espe-
cially it was noticed that the latter two substances caused plasmoptysis at the tip
of the protuberance (Fig. 1C). This may exhibit that the tip region of the rhizoid
protuberance formed with these agents is very weak in the cell wall. The similar
plasmoptysis was reported by Nakazawa\(^{5}\) in rhizoids developing under normal
conditions. These results may show that rhizoid differentiation in form of a protu-
berance, the “tear drop shape” as called by Bonner\(^{9}\), is the first step of rhizoid
formation and is distinct from the following elongation steps as stated by Nakazawa
and Takamura\(^{6}\). Moreover, it seems that some chemical and physical processes,
necessary for the development of the rhizoid protuberance, are able to proceed even
under the low temperature of 3\(^{\circ}\), while the further processes necessary for the
second step of the rhizoid development requires a higher temperature.

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